

### TITLE OF INVENTION

[0001] Side Foldable Wheelchair and Wheelchair Side Frame

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] This application claims the benefit of United States Provisional Application No. 60/539,033, filed January 23, 2004, the disclosure of which is incorporated herein by reference.

### BACKGROUND OF INVENTION

[0003] This invention relates in general to wheelchairs and wheelchair side frames and more particularly, to a wheelchair side frame for a side foldable wheelchair.

[0004] A conventional wheelchair typically has a side frame that includes forward and rearward vertical side frame members and upper and lower horizontal side frame members arranged to form a generally rectangular frame structure, which is typically oriented in a vertical plane. Generally the lower frame member is supported by a drive wheel and by a caster, usually located at the front of the wheelchair. To achieve this the lower frame member may extend longitudinally from the drive wheel to the caster or additional connecting members may connect the lower frame member to the drive wheel or caster.

[0005] One of the factors in the cost of producing a wheelchair is the amount of material required. Another factor in the cost is the number and intricacy of the members of a wheelchair. One of the factors in the convenience of a wheelchair is the weight of the wheelchair, which is related to the amount of material required to produce the wheelchair. It would be advantageous to have a wheelchair that required less material or had less intricate members.

[0006] What is needed is a wheelchair that overcomes the aforementioned deficiencies.

### SUMMARY OF INVENTION

[0007] This invention relates to a wheelchair side frame assembly that includes at least one vertical side frame member having upper and lower ends. The upper end of the vertical side frame member is secured to an upper side frame member. An axle housing is secured to the vertical side frame member. A cross brace hinge is secured directly to the vertical side frame member.

[0008] This invention also relates to a side foldable wheelchair including at least one substantially horizontally extending upper side frame member, and at least one vertical side frame member having upper and lower ends, the upper end secured to the upper side frame member. An axle housing is secured to the vertical side frame member, and a cross brace hinge is secured directly to the vertical side frame member. The axle housing and the cross brace hinge are substantially equidistant from the upper side frame member. A cross brace is secured to the vertical side frame member via the cross brace hinge. The cross brace hinge is operable to pivot the cross brace with respect to the vertical frame member.

[0009] Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment, when read in light of the accompanying drawings.

### BRIEF DESCRIPTION OF DRAWINGS

[0010] Fig. 1 is a side perspective view of a wheelchair according to a preferred embodiment of the invention with one main drive wheel partially broken away and a corresponding armrest removed.

[0011] Fig. 2 is a partial rear perspective view of the wheelchair of Fig. 1 with the main drive wheels removed.

[0012] Fig. 3 is a partial front perspective view of the wheelchair of Fig. 1 with the main drive wheels, and armrests removed.

[0013] Fig. 4 is a partial bottom perspective view of the wheelchair of Fig. 1 with the main drive wheels removed.

[0014] Fig. 5 is a side schematic view in elevation of a portion of the left side frame of the wheelchair of Fig. 1.

[0015] Fig. 6 is a rear schematic view in elevation of the portion of the left side frame of Fig. 5 without the upper side frame member.

[0016] Fig. 7 is a bottom schematic view of the portion of the left side frame of Fig. 6.

[0017] Fig. 8 is a side schematic view in elevation of a portion of a left side frame of a wheelchair according to an alternative embodiment of the invention.

[0018] Fig. 9 is a side perspective view of a wheelchair according to another alternative embodiment of the invention.

[0019] Fig. 10 is an enlarged side perspective view of a portion of the wheelchair of Fig. 9.

[0020] Fig. 11 is a side perspective view of the wheelchair of Fig. 9.

[0021] Fig. 12 is a side perspective view of the wheelchair of Fig. 9.

[0022] Fig. 13 is a rear perspective view of the wheelchair of Fig. 9.

[0023] Fig. 14 is a rear perspective view of the wheelchair of Fig. 9.

[0024] Fig. 15 is an enlarged rear perspective view of a portion of the wheelchair of Fig. 9.

[0025] Fig. 16 is a rear perspective view of the wheelchair of Fig. 9.

[0026] Fig. 17 is a side perspective view of the wheelchair of Fig. 9.

[0027] Fig. 18 is an enlarged side perspective view of a portion of the wheelchair of Fig. 9.

[0028] Fig. 19 is a front perspective view of the wheelchair of Fig. 9.

[0029] Fig. 20 is a front perspective view of the wheelchair of Fig. 9 with the main drive wheels removed.

[0030] Fig. 21 is a side perspective view of the wheelchair of Fig. 9 with the main drive wheels removed.

[0031] Fig. 22 is an enlarged side perspective view of a portion of the wheelchair of Fig. 9 with the main drive wheels removed.

[0032] Fig. 23 is a side perspective view of the wheelchair of Fig. 9 with the main drive wheels removed.

[0033] Fig. 24 is a side perspective view of the wheelchair of Fig. 9 with the main drive wheels removed.

[0034] Fig. 25 is a side perspective view of the wheelchair of Fig. 9 with the main drive wheels removed.

[0035] Fig. 26 is a bottom perspective view of the wheelchair of Fig. 9 with the main drive wheels removed.

[0036] Fig. 27 is an enlarged bottom perspective view of a portion of the wheelchair of Fig. 9 with the main drive wheels removed.

[0037] Fig. 28 is an enlarged bottom perspective view of a portion of the wheelchair of Fig. 9 with the main drive wheels removed.

[0038] Fig. 29 is an enlarged bottom perspective view of a portion of the wheelchair of Fig. 9.

[0039] Fig. 30 is an enlarged bottom perspective view of a portion of the wheelchair of Fig. 9.

#### DETAILED DESCRIPTION OF THE INVENTION

[0040] Referring now to the drawings, there is shown in Fig. 1 a wheelchair 10 in accordance with the present invention. As best seen in Figs. 1-4, the wheelchair 10 includes a pair of spaced apart side frames, namely, a left side frame 12a and a right side frame 12b. As will be discussed below, the side frames 12a and 12b are each secured to a respective upper side frame member 14a and 14b.

[0041] The wheelchair 10 is generally longitudinally symmetrical, with the right side substantially being the mirror image of the left. Except when otherwise discussed, when a part or component is described on one side, it is to be understood that the wheelchair 10 has similar structure on the opposite side. For example, the wheelchair 10 further includes a pair of seat frame members, such as a left seat frame member 16a and a right seat frame member 16b, and a pair of seat back frame members, such as a left seat back frame member 32a and a right back frame member 32b.

[0042] The seat frame members 16a and 16b are adapted to be supported by upper side frame members 14a and 14b, respectively. Preferably, the upper side frame members 14a and 14b are provided with couplings, such as the saddles 17a and 17b, shown in Fig. 4, for supporting the seat frame members 16a and 16b relative to the upper side frame members 14a and 14b. A seat sling 30 extends substantially horizontally between the seat frame members 16a and 16b. The seat sling 30 forms a seat for supporting a wheelchair occupant. Although a sling 30 is shown, it should be understood that the invention may be practiced with other seat components, such as removable or folding panels (not shown).

[0043] The seat back frame members 32a and 32b may be secured to the upper side frame members 14a and 14b by brackets 33a and 33b, respectively. A seat back 36 extends substantially vertically between the seat back frame members 32a and 32b and is secured to the seat back frame members 32a and 32b by a plurality of straps 35a and 35b. However, the seat back frame members 32a and 32b and the seat back 36 may be secured in any suitable manner. Optionally, the seat back 36 can be adjustable in elevation by raising and lowering the seat back 36 relative to the seat back frame members 32a and 32b. Upper ends of the seat back frame members 32a and 32b may be provided with optional attendant handles 34a and 34b to aid an attendant in maneuvering the wheelchair 10.

[0044] Main drive wheels 52a and 52b support the rear end of the wheelchair 10. The main drive wheels 52a and 52b are adapted to be driven by the wheelchair occupant to propel and maneuver the wheelchair 10. In accordance with the preferred embodiment of the present invention, axle housings 54a and 54b are provided for mounting the main drive wheels 52a and 52b to the side frames 12a and 12b, respectively, as will be described below.

[0045] As shown in the drawings, the upper side frame members 14a and 14b are preferably adapted to support armrest assemblies 38a and 38b, respectively.

The arm rests assemblies 38a and 38b are secured to the upper side frame members 14a and 14b and to the seat back frame members 32a and 32b preferably by a plurality of threaded fasteners 39a and 39b, and the arm rests assemblies 38a and 38b are preferably configured to act as armrests and side guards, or wheel guards. The armrest assemblies 38a and 38b are sufficiently low to permit a wheelchair occupant to gain access to the main drive wheels 52a and 52b, which will be described herein below. The armrest assemblies 38a and 38b are provided for support of an occupant's arms, and may also include or incorporate an optional clothing protector, as shown, to protect the wheelchair occupant's person or apparel from being caught in the spokes of the main drive wheels 52a and 52b.

[0046] Extending from the front of the wheelchair 10 is an optional footrest assembly 44. The footrest assembly 44 includes extension frame members 46a and 46b and a footplate 48. The extension frame members 46a and 46b extend forwardly and downwardly from the upper side frame members 14a and 14b, respectively. The footplate 48 is attached to the lower ends of the extension frame members 46a and 46b. Preferably, the footplate 48 is attached to the right extension frame member 46b by a pivotal connection, indicated generally at 47, and the footplate 48 is attached to the left extension frame member 46a by a selectively engagable support connection, indicated generally at 49. Thus, the

footplate 48 may be engaged when the wheelchair 10 is to be in normal use and the footplate 48 may be disengaged when the wheelchair 10 is to be folded.

Alternatively, separate or independent lateral leg supports (not shown) can also be supported by the extension frame members 46a and 46b.

[0047] Front casters 50a and 50b support the front end of the wheelchair 10 relative to a supporting surface. The front casters 50a and 50b may be affixed to the wheelchair 10 in any suitable manner. For example, as shown, the front casters 50a and 50b are preferably joined to the upper side frame members 14a and 14b, by caster housings 51a and 51b, respectively, that are secured to the lower front ends of the upper side frame members 14a and 14b, respectively. Bearings within the caster housings 51a and 51b enable the front casters 50a and 50b to swivel about vertical axes for maneuverability of the wheelchair 10.

[0048] Each side frame 12a and 12b includes a forward vertical side frame member, 61a and 61b respectively, and a rearward vertical side frame member, 63a and 63b respectively. As shown, the forward vertical side frame members 61a and 61b, and the rearward vertical side frame members 63a and 63b, have a rectangular cross-sectional shape. It must be understood, however, that the forward vertical side frame members 61a and 61b, and the rearward vertical side frame members 63a and 63b can have any suitable cross-sectional shape, such as, square, round, oval or any other suitable shape.

[0049] The side frames 12a and 12b are joined to opposite horizontal seat frame tubes or members 16b and 16a, respectively, by respective cross brace members 22a and 22b. Lower ends of the cross brace members 22a and 22b are pivotally connected to the forward vertical side frame members 61a and 61b and the rearward vertical side frame members 63a and 63b of the side frames 12a and 12b by respective hinge assemblies, indicated generally at 65a and 65b. Upper ends of the cross brace members 22a and 22b are connected to opposite seat frame members 16b and 16a, preferably by threaded fasteners 67a and 67b.

The seat frame members 16b and 16a preferably include a plurality of discretely spaced threaded bores 69a and 69b, as shown in Fig. 4, preferably set at regular intervals, to receive the threaded fasteners 67a and 67b respectively. The discretely spaced threaded bores 69a and 69b permit the cross brace members 22a and 22b to be secured to the seat frame members 16b and 16a at a variety of forward and rearward longitudinal locations, thus allowing for adjustment in the placement of the cross brace members 22a and 22b and thus also allowing for adjustment in the placement of the side frames 12a and 12b.

[0050] The cross brace members 22a and 22b are pivotally connected to each other by a pivot pin 71, at approximately the middle of the cross brace members 22a and 22b. The cross brace members 22a and 22b are foldable to permit the wheelchair 10 to be folded into a compact form. The wheelchair 10 is foldable into a compact form to permit the wheelchair 10 to be easily transported and stored.

[0051] As shown, the hinge assemblies 65a and 65b are laterally aligned, i.e. positioned and oriented in similar forward to rearward placement and direction. The cross brace members 22a and 22b are also laterally aligned at their respective connections to the seat frame members 16b and 16a, and their respective connections to the hinge assemblies 65a and 65b. However, the cross brace members 22a and 22b are preferably curved, or offset forwardly and rearwardly, i.e. longitudinally, as shown in Fig. 4, at the pivot pin 71. The cross brace member 22a is curved, or bowed forward at the pivot pin 71, while the cross brace 22b is curved rearward at the pivot pin 71.

[0052] As best seen in Figs. 5-7, the left side frame member 12a generally includes the forward vertical side frame member 61a, the rearward vertical side frame member 63a, the axle housing 54a, the hinge assembly 65a, and a clamp 73a. Although the vertical side frame members 61a and 63a are shown



extending downward from the left upper side frame member 14a, it should be understood the invention may be embodied in other configurations.

[0053] The clamp 73a includes an outer flange 75a and an inner flange 77a. Preferably, the flanges 75a and 77a are formed integrally to the forward vertical side frame member 61a and the rearward vertical side frame member 63a. The flanges 75a and 77a form a saddle 79a in the clamp 73a. The saddle 79a is suitable to receive the left upper side frame member 14a. The clamp 73a may further include a pair of threaded fasteners 81a to secure the two flanges 75a and 77a together. The left upper side frame member 14a is disposed in the saddle 79a and the two flanges 75a and 77a surround the left upper side frame member 14a and are secured to each other by the threaded fasteners 81a. Thus, the left side frame 12a is secured to the left upper side frame member 14a by the clamp 73a. The clamp 73a allows for adjustment in the longitudinal position of the left side frame 12a. It must be understood, however, that the forward vertical side frame member 61a and the rearward vertical side frame member 63a may be secured to the left upper side frame member 14a in any suitable manner, such as by direct welding or nut and bolt fasteners.

[0054] The axle housing 54a preferably includes an axle tube 83a suitable to receive the axle of the left main drive wheel 52a. The forward and rearward vertical side frame members 61a and 63a may include a plurality of discretely spaced threaded bores 85a and 87a. A front groove, or slot, 89a and a rear groove, or slot, 91a may be formed in the axle housing 54a to receive the forward vertical side frame member 61a and the rearward vertical side frame member 63a respectively, as shown in Fig. 7. The axle housing 54a is secured to the forward vertical side frame member 61a and the rearward vertical side frame member 63a by one or more threaded fasteners 93a. However, the axle housing 54a may alternatively be secured to the forward vertical side frame member 61a and the rearward vertical side frame member 63a in any other suitable manner,

such as with rivets, or by welding, for example. Preferably, the axle housing 54a matingly engages the forward vertical side frame member 61a and the rearward vertical side frame member 63a by a sliding, tongue and groove engagement. The axle housing 54a is preferably adjustable as to slide up and down between the forward vertical side frame member 61a and the rearward vertical side frame member 63a and be secured to appropriate threaded bores 85a and 87a, thus allowing for adjustment of the height of the rear of the wheelchair 10 relative to the main drive wheels 52a and 52b.

[0055] When the axle housing 54a is positioned at the bottom end of the vertical side frame members 61a and 63a, as shown in Fig. 5, the left vertical side frame 12a is formed in a substantially rectangular shape. However, it must be understood that the left vertical side frame 12a may be any suitable shape. For example, when the forward vertical side frame member 61a and the rearward vertical side frame member 63a are secured directly, i.e. not connected via another frame member, to the left upper side frame member 14a and the axle housing 54a and the hinge assembly 65a are positioned in the middle (vertically) of the forward vertical side frame member 61a and the rearward vertical side frame member 63a from top to bottom, the left vertical side frame 12a forms a substantially H-shaped side frame, and the left vertical side frame 12a can be said to have no bottom frame member, as shown in Fig. 8.

[0056] Further, while the left vertical side frame 12a has been describe has having the axle housing 54a and the hinge assembly 65a positioned either at the bottom end of the vertical side frame members 61a and 63a, as shown in Fig. 5, or alternatively in the middle (vertically) of the vertical side frame member 61a and 63a from top to bottom, as shown in Fig. 8, and the axle housing 54a and the hinge assembly 65a thus being equidistant from the left upper side frame member 14a, it must be understood, however, that and the axle housing 54a and the hinge assembly 65a may be positioned in any suitable equidistant position or

alternatively and the axle housing 54a and the hinge assembly 65a may be positioned in any suitable independent or unequidistant position, such as the axle housing 54a being positioned in the middle (vertically) of the vertical side frame member 61a and 63a from top to bottom, and the hinge assembly 65a being positioned at the bottom end of the vertical side frame members 61a and 63a.

[0057] The left side frame 12a is joined to the cross brace 22a by the hinge 65a. Generally, hinges include two leaves, or wings, with one leaf pivoting with respect to the other leaf about a common axis of rotation, or pin. Each leaf may include one or more fingers or brackets which serve to connect the leaf to an object, or part, which is to pivot with the leaf with respect to the other leaf and another object, or part, connected to the other leaf. As shown in Figs. 5-7, the hinge 65a includes a first leaf front finger, or bracket, 95a and a first leaf rear finger, or bracket, 97a. The first leaf front finger 95a is secured directly to the forward vertical side frame member 61a, for example, by threaded fasteners 99a. The first leaf rear finger 97a is secured directly to the rearward vertical side frame member 63a, for example, by threaded fasteners 101a. The first leaf front finger 95a includes a first leaf front hinge knuckle portion 103a. A front hinge pin hole, or bore 104a extends through the first leaf front hinge knuckle portion 103a. A first end 102a of a substantially longitudinal hinge pin 105a is inserted within the front hinge pin hole 104a and surrounded by the front hinge knuckle portion 103a. The first leaf rear finger 97a includes a first leaf rear hinge knuckle portion 107a. A rear hinge pin hole, or bore, 108a extends through the first leaf rear hinge knuckle portion 107a. A second end 106a of the hinge pin 105a is inserted within the rear hinge pin hole 108a and surrounded by the rear hinge knuckle portion 107a.

[0058] As shown in Fig. 6, the lower end of the cross brace 22a includes an integrally formed second hinge leaf portion 109a. The formed second hinge leaf portion 109a includes a second leaf knuckle portion 111a (see Fig. 7) that is

disposed between the first leaf front hinge knuckle portion 103a and the first leaf rear hinge knuckle portion 107a. A middle hinge pin hole, or bore, 115a extends through the second leaf knuckle portion 111a. The hinge pin 105a is inserted within the middle hinge pin hole 115a. The hinge pin 105a thus extends longitudinally through the front hinge pin hole 104a, the middle hinge pin hole 115a, and the rear hinge pin hole 108a. The hinge 65a is thus operable to pivot the cross brace 22a with respect to the left side frame 12a. However, the hinge 65a may alternatively be formed in any suitable manner. For example, the hinge pin 105a may be formed integrally to the second leaf knuckle portion 111a. The second leaf knuckle portion 111a would not have a middle hinge pin hole 115a and the hinge pin 105a may then be described as two knobs protruding from opposite ends of the second leaf knuckle portion 111a.

[0059] Although the hinge 65a has been described as including substantially longitudinal hinge pin 105a, it must be understood however that the hinge pin 105a may be oriented in any suitable manner. For example, if the pivot pin 71 is oriented vertically, and the cross braces 22a and 22b are suitably connected to the seat frame members 16a and 16b, the hinge pin 105a may be a vertically oriented hinge pin.

[0060] The principle and mode of operation of this invention have been explained and illustrated in its preferred embodiment. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.